# Lesson 1- Introductory Lesson-Determination of Overall Water Quality Using a Quantitative Macroinvertebrate Survey

## Objectives:

Students will be able to:

-identify various types of macroinvertebrates found in water ecosystems.

-perform a quantitative macroinvertebrate survey to determine the overall water quality of a water ecosystem.

## Materials:

Water sample from a local stream or pond (sample must be fresh and contain debris from the bottom and edges of the water)

Macroinvertebrate Identification charts

Assorted trays and petri dishes for separation of sample

Dissecting microscope and hand lenses

Small paintbrushes

Pipets

## Procedure:

1. Working with a partner, take an approximate 500 ml sample of the water including the debris.

2. Pour a portion of the sample into a petri dish and examine it under low power on the microscope.

3. Using the identification charts, count and identify 100 macroinvertebrates. Try not to

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hunt for only the large ones or your sample will be biased. If you can not find 100 macroinvertebrates in your sample, take an additional 500 ml sample. Continue this procedure until you and your partner have counted and identified 100 macroinvertebrates.

4. Identify and count the numbers of each type of organism listed below.

5. Multiply the number of each type by its biotic value.

6. Add up all the numbers and divide by 10. This gives the Biotic Index Value. Check the Biotic Value chart at the bottom of the page to determine the quality of your water sample.

7. Compare your group value with the class values. Do they agree? Why or why not?

**Class I** Pollution intolerant: These organisms are highly sensitive to pollution.

**Class II** Somewhat pollution tolerant: These organisms will be found in clean and slightly polluted waterways.

**Class III** Pollution tolerant: These organisms will be found in polluted, as well as clean aquatic ecosystems.

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| Class I | Biotic Value | Number Found | Class II | Biotic Value | Number Found | Class III | Biotic Value | Number Found |
|---|---|---|---|---|---|---|---|---|
| Stonefly nymph | 10 | | Beetle larva | 8 | | Midge fly larva | 5 | |
| Mayfly nymph | 10 | | Sowbug | 8 | | Snails | 4 | |
| Dobsonfly larva | 10 | | Scud | 6 | | Leech | 2 | |
| Caddisfly larva | 10 | | Clams, Mussels | 6 | | Aquatic worms | 0 | |
| Riffle beetle | 10 | | Crayfish | 6 | | | | |
| Water penny | 10 | | Cranefly larva | 6 | | | | |
| | | | Dragonfly nymph | 6 | | | | |
| | | | Damselfly nymph | 6 | | | | |
| | | | Black fly larva | 6 | | | | |
| Total | | | Total | | | Total | | |

For example if you find:

| | |
|---|---|
| 25 mayflies | 25 x 10 = 250 |
| 15 caddisflies | 15 x 10 = 150 |
| 20 stoneflies | 20 x 10 = 200 |
| 20 scuds | 20 x 6 = 120 |
| 20 midge larva | 20 x 5 = 100 |
| Total | = 820 / 10 = 82 |

Based on the Biotic Index value the water quality is excellent.

**Biotic Index**

| | |
|---|---|
| Excellent | >70 |
| Good | 60-79 |
| Fair | 40-59 |
| Poor | <40 |

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## Lesson 2- pH and Macroinvertebrate Populations-Do Changes in the pH Level Effect an Aquatic Ecosystem?

### Objectives:

Students will be able to:

-determine if changes in pH effect the quality of an aquatic ecosystem.

-evaluate the optimal pH levels for a macroinvertebrate population.

### Materials:

Water sample from a local stream or pond (sample must be fresh and contain debris from the bottom and edges of the water)

Macroinvertebrate Identification charts

300 ml beakers or jars to set up miniature water ecosystems

Dissecting microscope and hand lenses

1% NaOH in dropper bottles

1% HCl in dropper bottles

Wide range pH paper or pH probe

Pipettes

**Note**: Aeration of the samples is preferable during the 24 hour period, because of the susceptibility of some of the aquatic organisms to environmental changes. The organisms which are the most susceptible are the ones which are intolerant to pollution. As the dissolved oxygen levels decrease, the organisms will rapidly die off. The dissolved oxygen levels begin to decrease almost immediately after the sample is taken from the water.

**Note:** Safety goggles and aprons should be worn at all times during this lab activity.

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**Procedure:**

1. Working with a partner, take an approximate 1000 ml sample of the water including the debris.

2. Pour a portion of the sample into a petri dish and examine it under low power on the microscope or with a hand lens. Record your observations of the water sample.

Observations

1.

2.

3.

4.

5.

3. Using the identification charts, identify the predominant species of macroinvertebrate found in your water sample.

4. Once an identification has been made, separate the 1000 ml sample into five separate containers of 200 ml samples and label in the following manner:

-Container 1- pH 1

-Container 2- pH 4

-Container 3- pH 8

-Container 4- pH 12

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-Container 5- control

5. Add .1% HCl dropwise to container 1 until the liquid has a pH of 1. Test with pH paper after the addition of each drop.

6. Add .1% HCl dropwise to container 2 until the liquid has a pH of 4. Test with pH paper after the addition of each drop.

7. Add .1% NaOH dropwise to container 3 until the liquid has a pH of 8. Test with pH paper after the addition of each drop.

8. Add .1% NaOH dropwise to container 4 until the liquid has a pH of 12. Test with pH paper after the addition of each drop.

9. Do not add anything to container 5. This is the control.

10. Place containers in a location where they will not be disturbed for a 24 hour period.

11. Based on the observations of your water sample, hypothesize about how the contents of each container will change after the 24 hour period.

**Hypothesis:**

**Results:**

After the 24 hour period, observe the contents of each container. Record your observations in the data table.

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**Data Table:**

| Container | Observations |
|---|---|
| **1-pH 1** | **1.** |
| **2-pH 4** | **2.** |
| **3-pH 8** | **3.** |
| **4-pH 12** | **4.** |
| **5-control** | **5.** |

**Conclusions:**

1. Does the data collected support your hypothesis? Explain.

2. Based on your observations, which container has the optimal pH level for the macroinvertebrate population?

3. Based on your observations, if the pH changes, will it effect an aquatic ecosystem?

4. What are some possible causes of a change in the pH of an aquatic ecosystem?

5. What other factors may have had an effect on the changes of your aquatic systems?

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## Lesson 3-Pesticides, Fertilizers and Macroinvertebrates-Does the Introduction of Pesticides and Fertilizers Alter an Aquatic Ecosystem?

### Objectives:

Students will be able to:

-determine if the introduction of pesticides and fertilizers can change the water quality of an ecosystem.

-evaluate how the introduction of pesticides and fertilizers can change an aquatic ecosystem in a simulated system.

### Materials:

Water sample from a local stream or pond (sample must be fresh and contain debris from the bottom and edges of the water)

Macroinvertebrate Identification charts

Small beakers or jars to set up miniature water ecosystems

Dissecting microscope and hand lenses

5% fertilizer solution in dropper bottles

5% pesticide solution in dropper bottles

pH paper or pH probe

Pipets

**Note:** Aeration of the samples is preferable during the 24 hour period, because of the susceptibility of some of the aquatic organisms to environmental changes. The organisms which are the most susceptible are the ones which are intolerant to pollution. As the dissolved oxygen levels decrease, the organisms will rapidly die off. The dissolved oxygen

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levels begin to decrease almost immediately after the sample is taken from the water.

**Note**: Safety goggles and aprons should be worn at all times during this lab activity.

**Procedure:**

1. Working with a partner, take an approximate 1000 ml sample of the water including the debris.

2. Pour a portion of the sample into a petri dish and examine it under low power on the microscope or with a hand lens.

3. Using the identification charts, identify the predominant species of macroinvertebrate and determine the pH level of the sample.

4. Once an identification has been made and the pH has been determined, separate the 1000 ml sample into five 200 ml samples in separate containers. Label each container in the following manner and add the listed amounts of fertilizer and pesticide solution to the properly labeled container.

-Container 1- 5 drops of 5% fertilizer solution

-Container 2- 20 drops of 5% fertilizer solution

-Container 3- 5 drops of 5% pesticide solution

-Container 4- 20 drops of 5% pesticide solution

-Container 5- control

5. Do not add anything to container 5. This is the control.

6. Place containers in a location where they will not be disturbed for a 24 hour period.

7. Hypothesize about how the contents of each container will change after the 24 hour period. In your hypothesis include a statement about pH.

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**Hypothesis:**

**Results:**

After the 24 hour period, observe the contents of each container. Record your observations in the data table. Determine the pH of each container and record the number in the data table.

**Data Table:**

| Container | Additions to containers | pH | Observations |
|---|---|---|---|
| 1 | 5 drops of 5% fertilizer solution | | |
| 2 | 20 drops of 5% fertilizer solution | | |
| 3 | 5 drops of 5% pesticide solution | | |
| 4 | 20 drops of 5% pesticide solution | | |
| 5-control | No additions | | |

**Conclusions:**

1. Does the data collected support your hypothesis? Explain.

2. Based on your observations, in which container was the survival rate of macroinvertebrates the highest? Why?

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3. Based on your observations, does the addition of pesticides and fertilizers to an ecosystem cause a disruption in the ecosystem? How is it disrupted?

4. What are some possible causes for an increase in the fertilizer or pesticide levels in an aquatic ecosystem?

5. What other factors may have had an effect on the changes of your aquatic systems?

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